Boiler and Furnace Efficiency Improvement with Low-Cost CO Sensor and Burner Control System

ITP 2004

Materials, Glass and Sensors Project Review Meeting

June 21, 2004

Washington, DC

TIAX Powered by Innovation since 1886

COEN COMPANY, INC.

Efficiency Improvement with Low Cost CO Sensor

Goal: Develop low cost O_2 trim control using in-situ CO sensor.

Challenge: CO concentrations low and variable with interference and contamination; optimum O_2 trim depends on capacity, transients, hardware hysteresis

Benefits: Excess air reduction for OIT boilers and furnaces; efficiency improvements saving 67 trillion Btu/yr in 2020.

FY05 Activities: Concept screening and bench-scale testing.

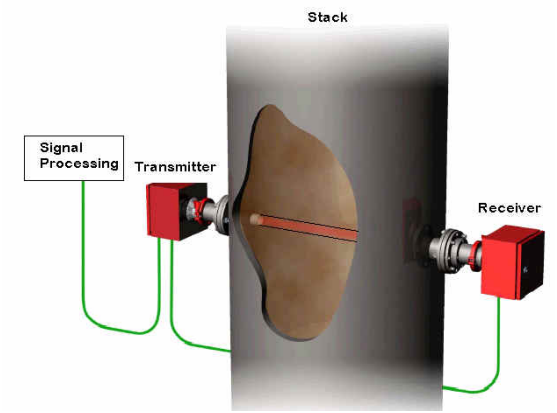


Figure 2

Participants:
TIAX LLC,
Coen Company

Efficiency Improvement with Low-Cost CO Sensor

Barriers

- CO/O_2 sensors expensive and/or unreliable
- Optimum, safe positioner setting requires CO feedback and I/O history

Pathways

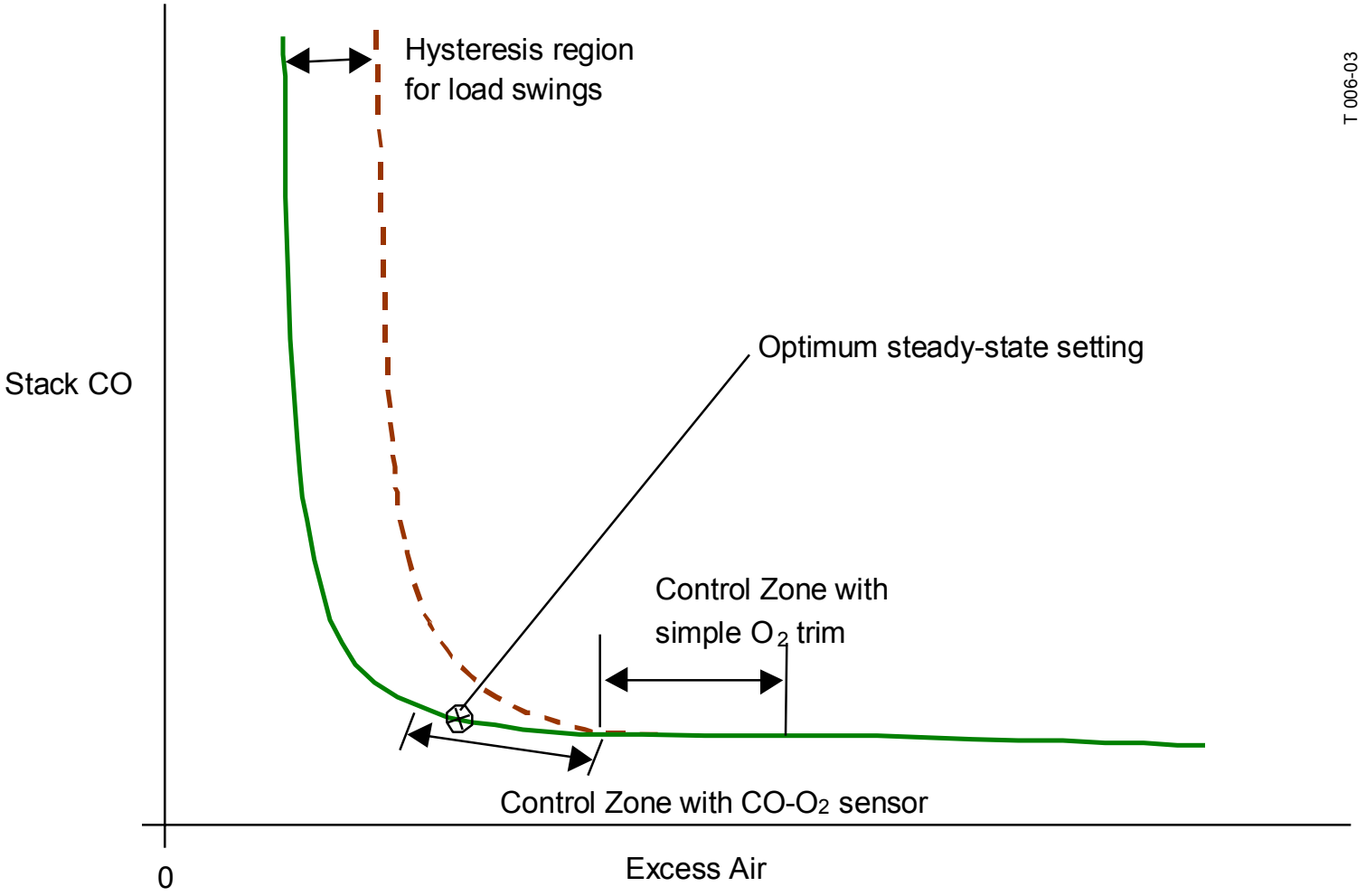
- Develop robust in-situ CO sensor for IOF applications
- Site specific neural network learned control response

Critical Metrics

- 0.3 to 0.7 percent efficiency improvement
- <$10,000 capital cost

Benefits	2020
Energy Savings	67 trillion Btu/yr
NO_x Reduction	850 TPY
Cost Savings	$435 M/yr

Excess Air Trim



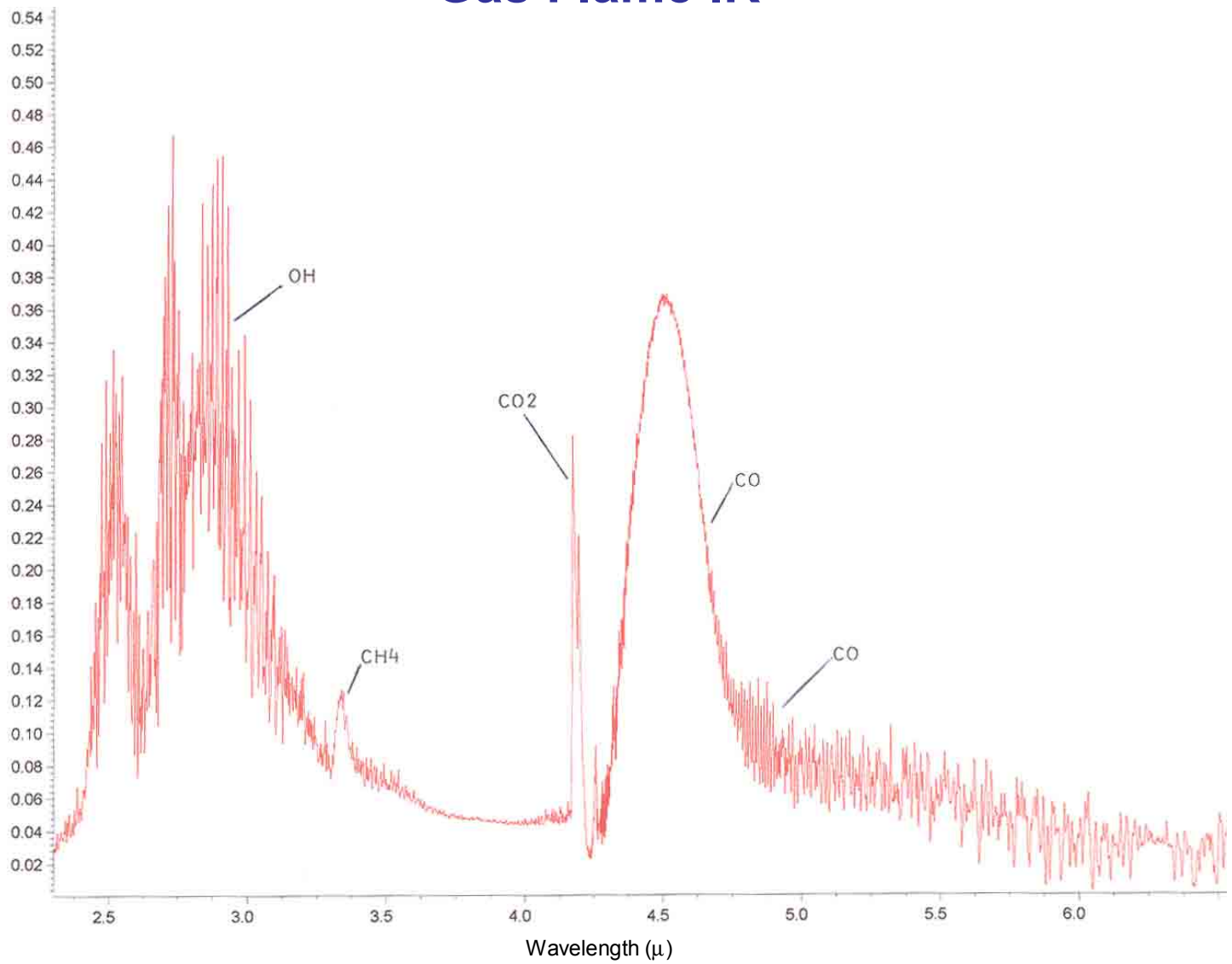
EA Trim Margins

Boiler Capacity lb/hr	EA Range	Minimum EA	Reduction %	Efficiency Benefit %
25	20-25	15	5-10	0.5
50	15-25	10	5-15	0.75
100	15-20	7	7-13	0.75
200	10-15	7	3-8	0.3
400	10-15	7	3-8	0.3

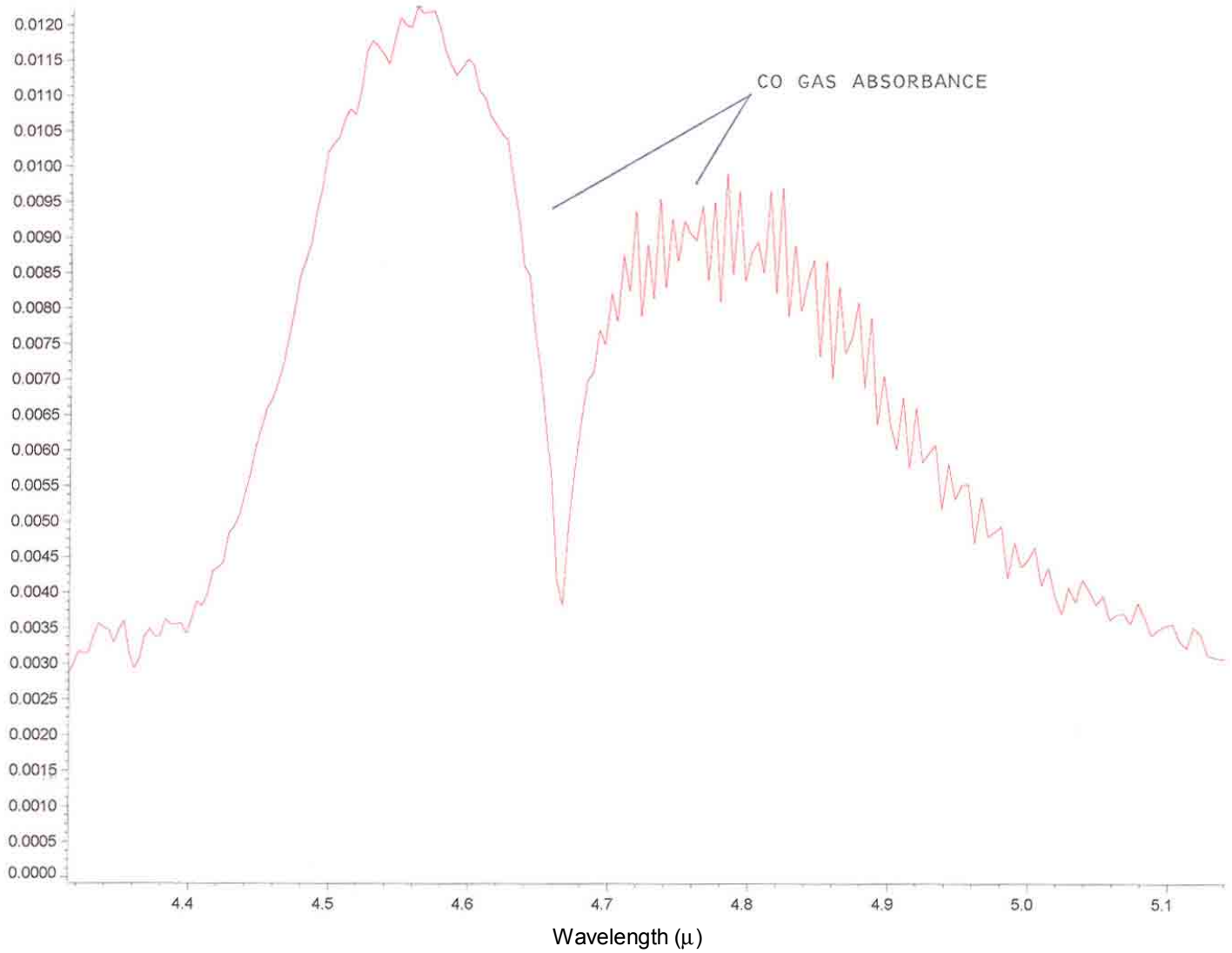
Benefits

Industry	1998 Energy, TBtu/yr	Energy Savings in 2002, TBtu	NO_x Increment Klb/yr
Aluminum	184	1.2	283
Castings	440	3.1	721
Chemicals	2,400	19.4	4,608
Forest prod/paper	659	5.6	1,508
Glass	157	0.6	139
Petroleum	2,252	13.7	3,224
Steel	851	7.3	1,732
Other	2,718	16.1	4,765
Total	9,671	67	16,980

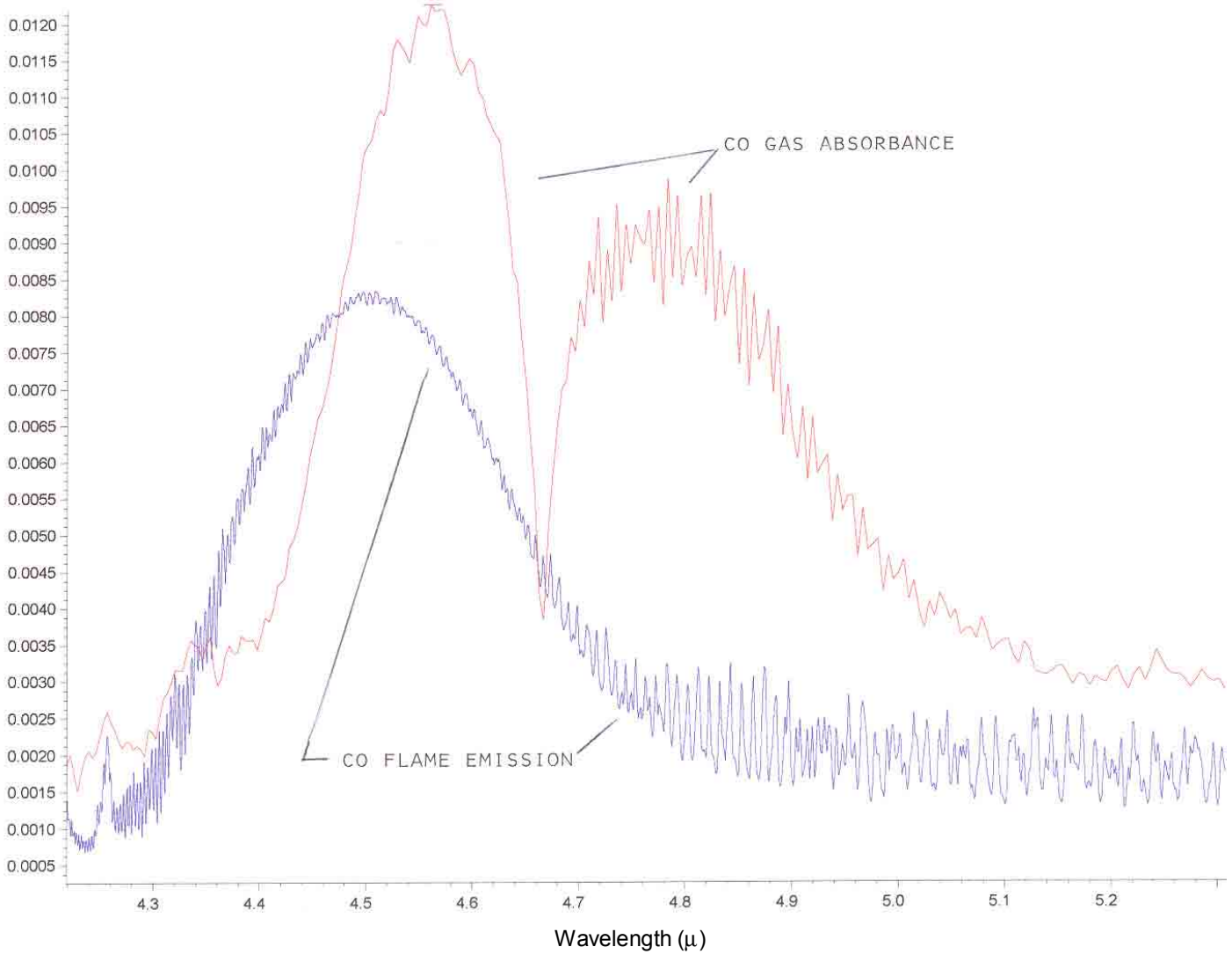
Gas Flame IR


0.54
0.52
0.50
0.48
0.46
0.44
0.42
0.40
0.38
0.36
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
OH
CO2
CO
CH4
CO
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
Wavelength (μ)

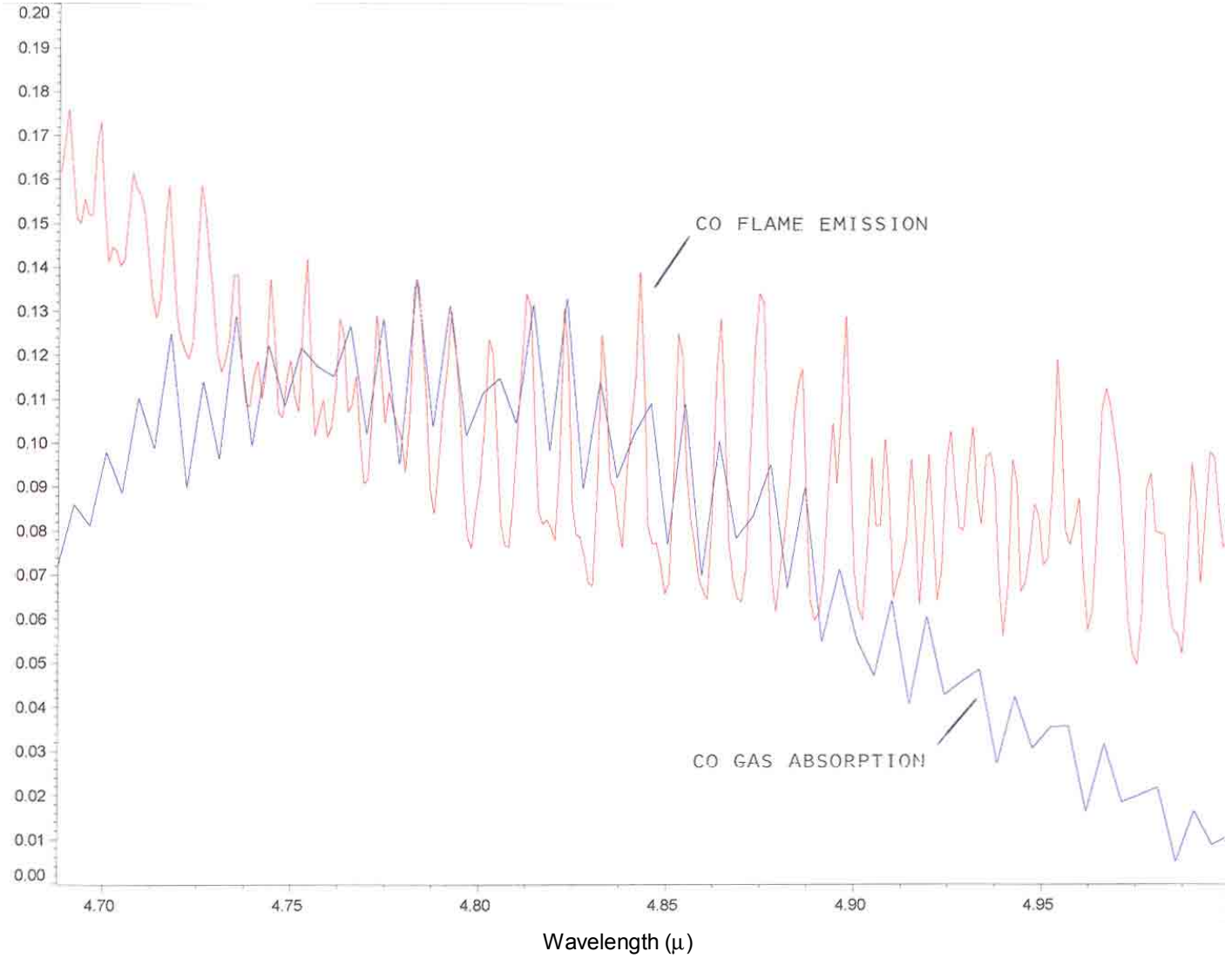
CO Absorbance



CO Emission and Absorbance



CO Emission and Absorbance



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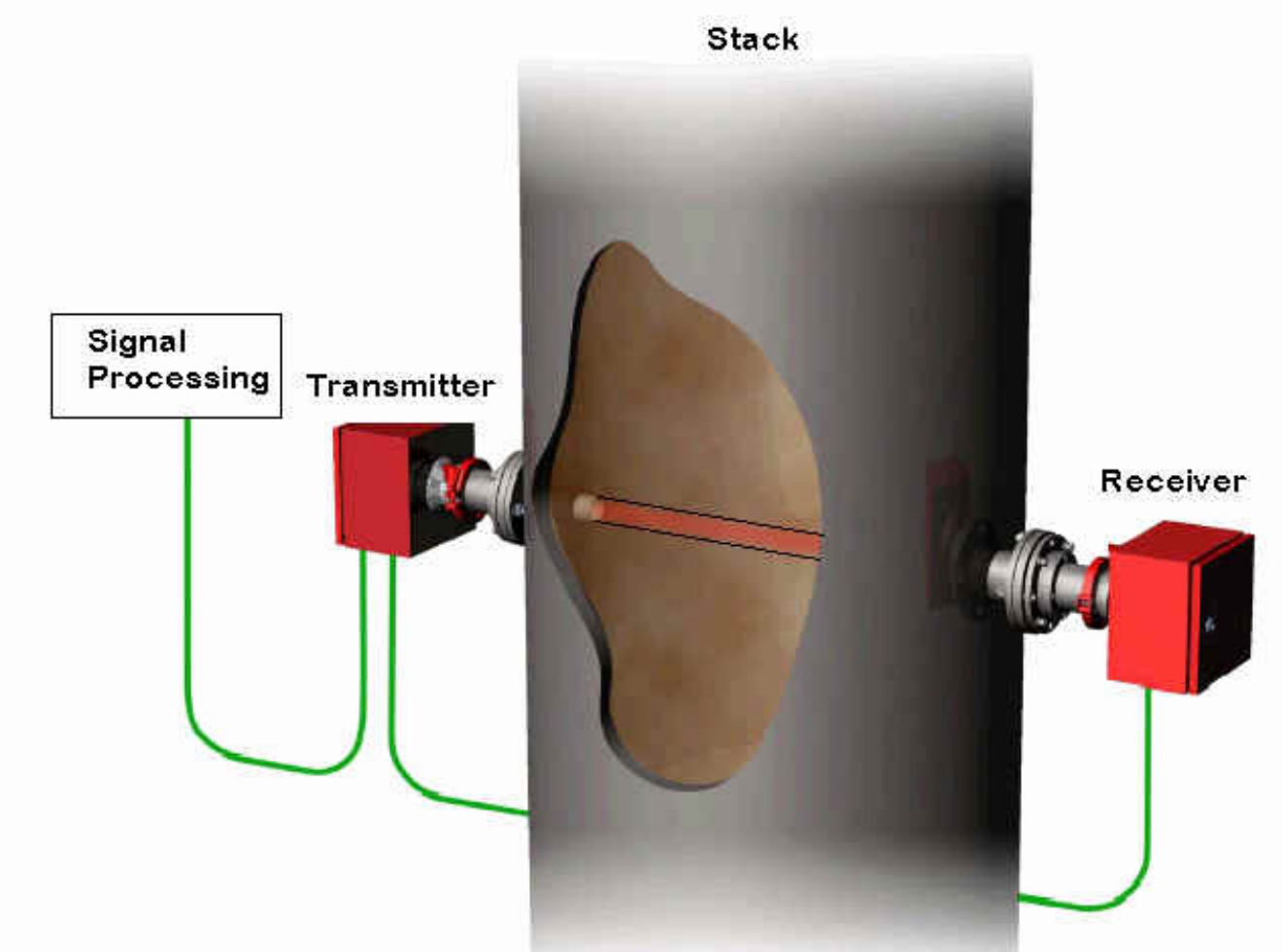
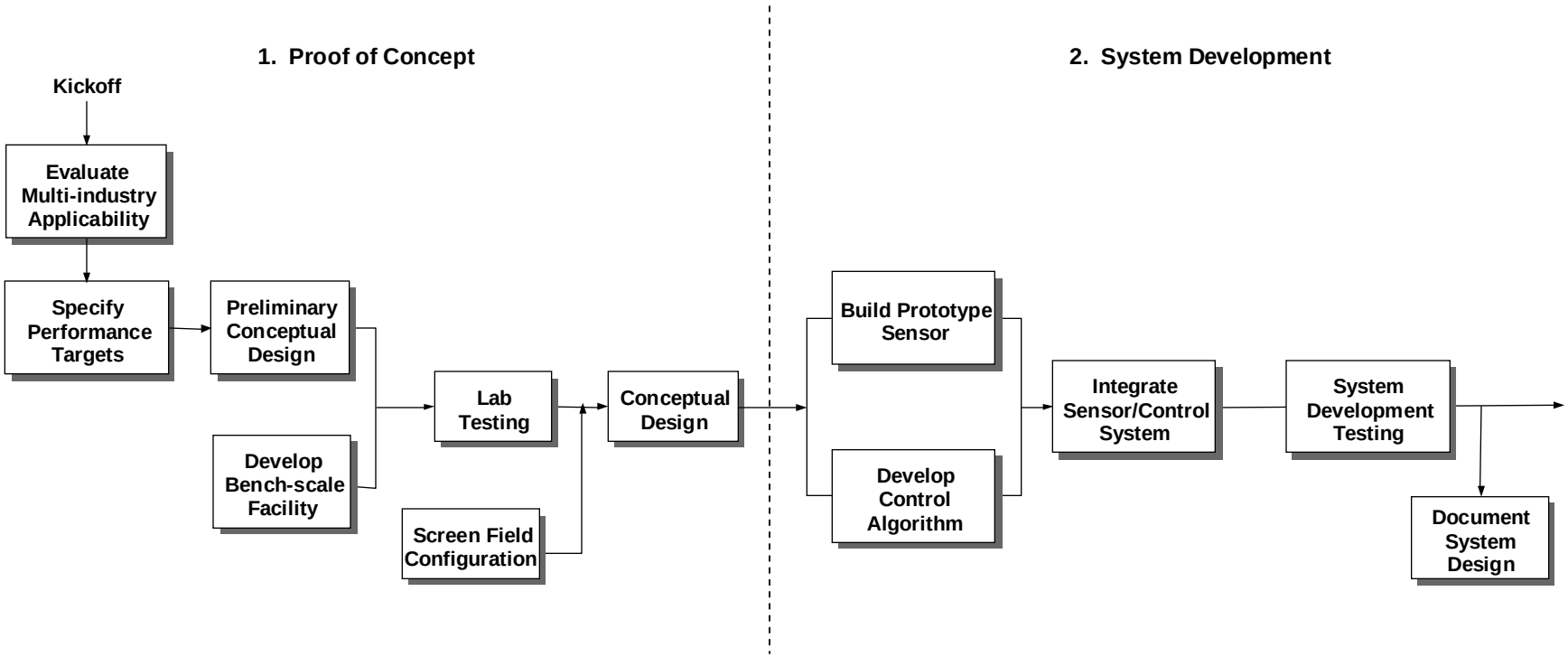
In-Situ CO Sensor



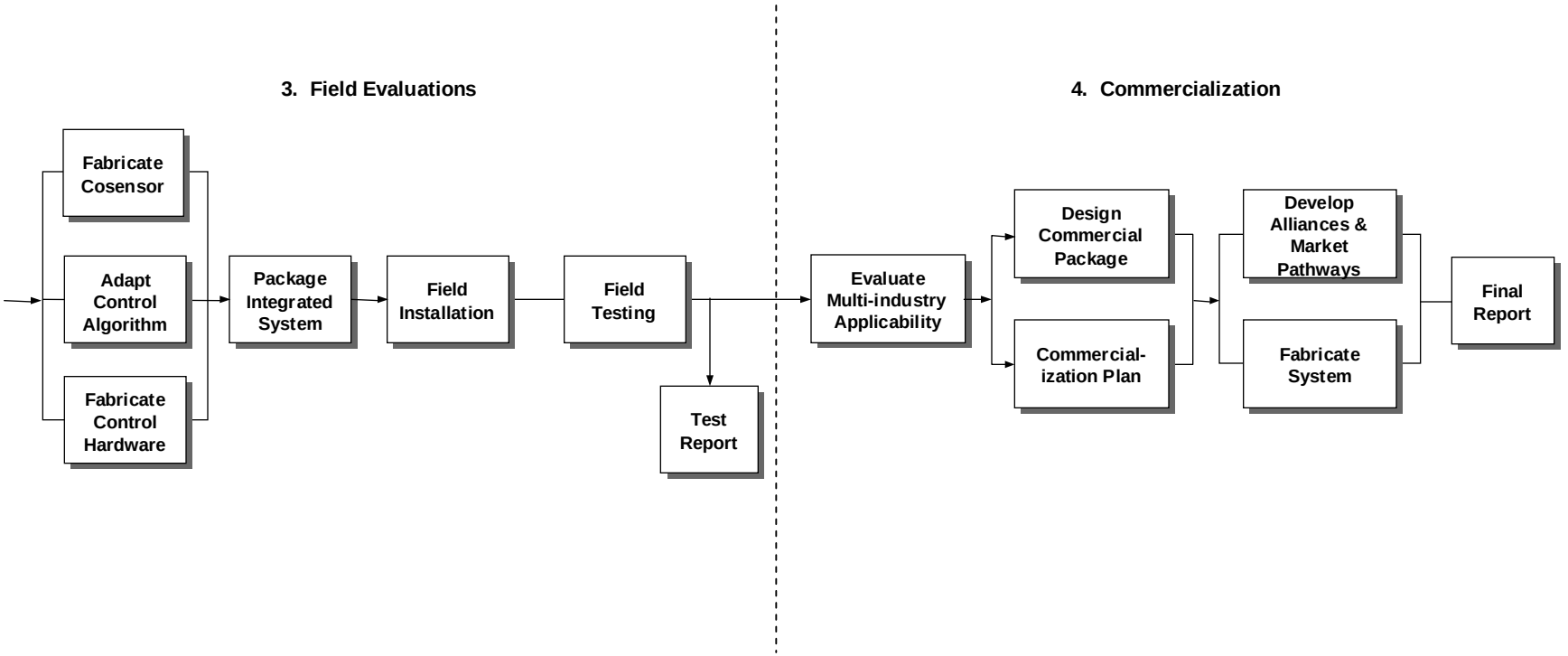
Control System

- Neural network overlay to BMS
  - O_2-CO response
- Trim to optimum CO-O_2 knee
  - Monitor CO-O_2 derivatives
  - Stored dead time response over capacity range
    - Emissions
    - Positioner
  - Transients and hysteresis
  - Learned response: adapt to drift

Technical Approach



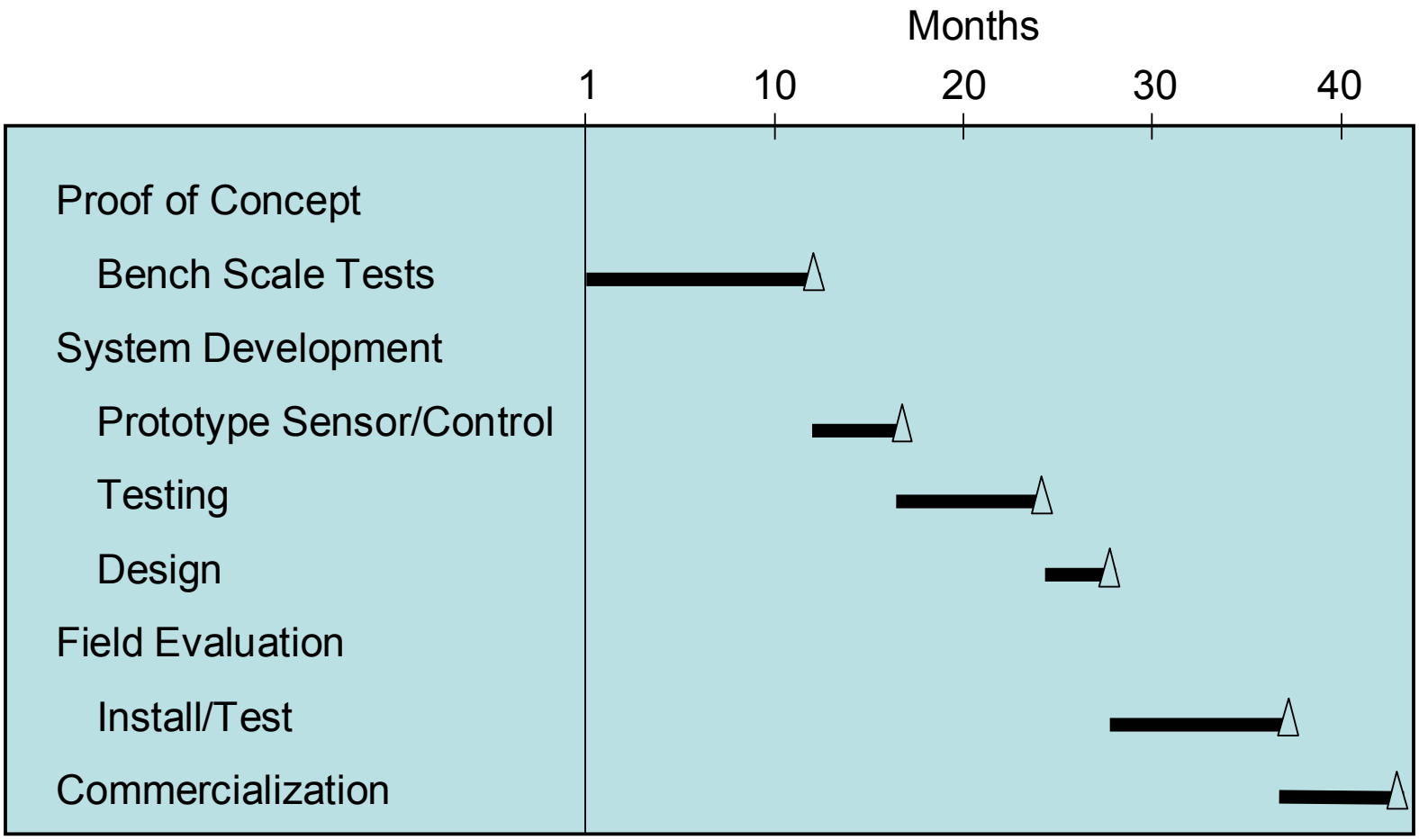
Technical Approach



Commercialization

- Coen manufacture and market
- Direct sales via Rep Network
- New equipment sales via OEMs
- Alliances with control system vendors
- Alliances with field engineers

Schedule


Months
1
10
20
30
40
Proof of Concept
Bench Scale Tests
System Development
Prototype Sensor/Control
Testing
Design
Field Evaluation
Install/Test
Commercialization